NOTES ON THE WEB OF *POECILOPACHYS AUSTRALASIA* (GRIFFITH AND PIDGEON, 1833) (ARANEIDA: ARGIOPIDAE)

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Introduction

Webs of many argiopid species show slight to marked modifications of what might be regarded as a 'typical' orb web, but the methods of construction are basically similar. However, some of the procedures used by *Poecilopachys australasia,* and certain characteristics of its finished orb web, differ markedly from those of any other species known to the author. Goodwin (1961) observes that this species makes an "irregular web", but does not make any specific reference to its structure. She also refers to its retreat position "on the under surface of a leaf".

The mature female of *P. australasia* is a small arboreal spider (8 mm) with a smooth, glossy integument coloured green, red, yellow and white. In spite of its bright colours, this spider is easily overlooked because of its size and habits, but where it occurs it does so in fair numbers, varying from year to year.

The web is usually built late at night, and only under favourable conditions. Calm, mild to warm, dewy nights seem to be preferred, and light rain does not preclude web-building. With few exceptions spiders under observation have not started web-building until at the earliest two hours after dark. Most started later, and the latest recorded was started about 1.30 a.m., but usually the last-observed web to be built on any given night was finished by approximately 2 a.m. What is left of the web is dismantled by the spider between first light and sunrise.

During the day the spider rests on the lower surface of a leaf on the edge of a tree or shrub. The leaf retreat is unmodified and usually not less than two feet from the ground but may be up to 15 feet high when other vegetation is available on the opposite side of a clear space to provide attachment points for the web. The retreat is used as a starting point for the construction of the web.

Terminology

In order to facilitate description of the web building procedure, it is necessary to introduce certain terms not previously used in the descriptions of orb webs. For this reason it is convenient to give a brief preliminary description of the finished web.

The web is asymmetrical to a more or less marked degree. *There is no spiral of any sort at any stage,* so the terms 'temporary spiral' and viscid spiral, are irrelevant. The operative part of the web consists, progressively outward from the hub, of (a) one or several more-or-less complete 'circles' which may be discontinued at one or more points where the silk is attached to a radial (R); and (b) a number of incomplete circles which span fewer and fewer sectors of the progressively towards the periphery at the lower part of the web, they may span only one or two sectors.

The term 'viscid spiral' needs to be replaced by a term will cover either complete circles or sections of circles, and the 'viscid line' (VL) is used here for this, although the lines are continuously viscid, and between radials they hang loosely enough give a scalloped appearance rather than forming a continuously line. For a single section of the viscid line that spans a sector between radials, the term 'spanning thread' (ST) seems adequate. In other a viscid line (VL) comprises one or more spanning threads (ST) may or may not encircle the hub.

The web and building procedures

The web is built on a frame which starts with two foundation lines forming a long, narrow V with the opening at the lower end third foundation line joins these two, completing and forming the line of a more-or-less equilateral triangle. The web is placed within triangle (fig. 1). In the finished web the base-line is not straight, pulled upward at several points, according to the number of attached to it, towards the hub.

The finished web is longitudinally inclined at an angle which vary from 45 degrees to almost horizontal. Each of the two longitudinal foundation lines may differ slightly from one another in their angle the horizontal, depending on the relative positions of the attachment points, so that the short axis of the framework may also be inclined downward, progressively from the point of commencement near the treat. In other words, the web as a whole may be inclined not lengthwise but also sideways. The maximum degree of inclination of short axis is usually less than that of the long axis.

The number of radial lines placed within the triangular frame small (see Table I). The converging radial lines form a hub is fairly high in the web and strengthened by a few spiral turns of The dry silk used for frame and radials is extremely fine, which explain the choice of windless nights for web-building.

The following is a step-by-step description of the observed behaviour of one mature female *P. australasia* after the placing of the lines. A diagrammatic plan of the finished web is appended (fig. together with a list of abbreviations.

1. The spider moves from the hub (H) down R6 to point 'a' attaches silk at that point, and returns to H drawing the silk behind her.
2. Just before reaching H, and without pausing, she starts paying from her spinnerets with the fourth tarsi a thick, clearly viscid silk which apparently moves out behind her along the silk thread, and stationary at H she continues this procedure

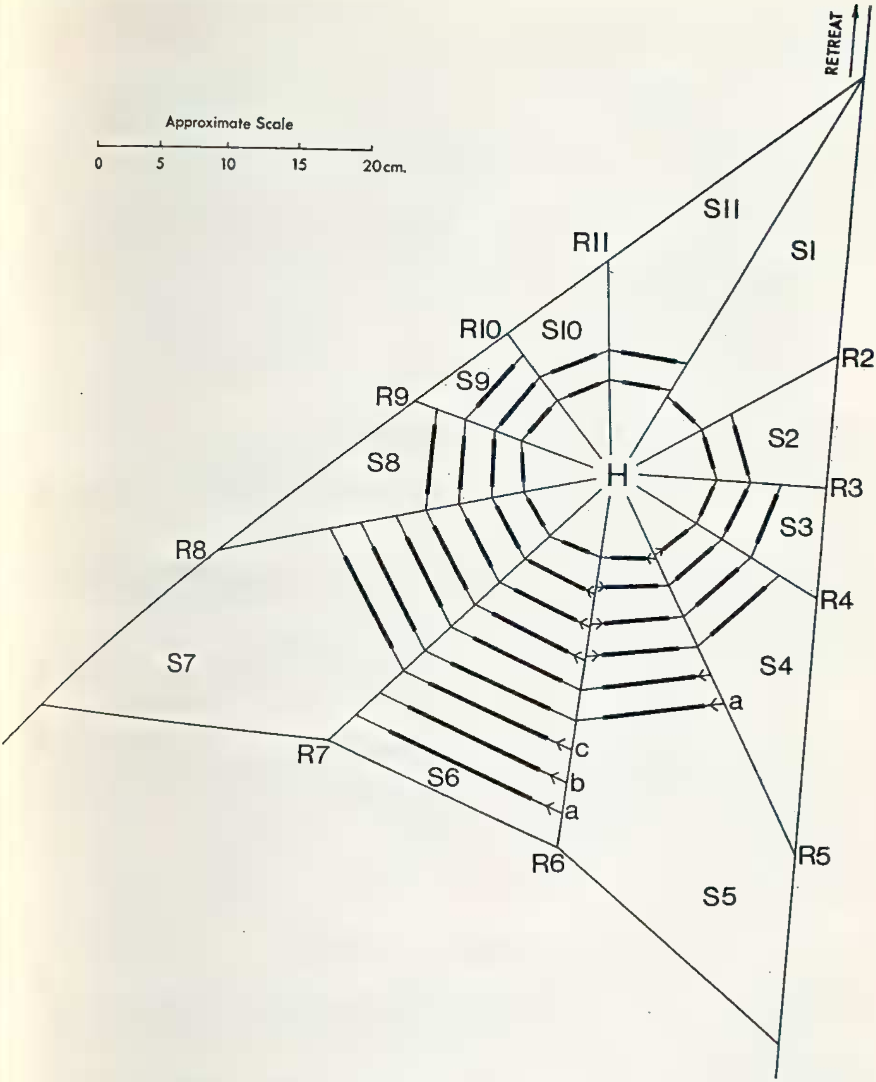

Figure 1

Diagrammatic representation of a large web of *P. australasia*

Abbreviations

H hub

R followed by a figure indicates a radial. These are numbered consecutively clockwise from the retreat, R1 being also the route taken by the spider to and from its rereat.

S followed by a figure indicates a sector. These are numbered consecutively clockwise from the retreat.

Small letters indicate points of attachment referred to in the text. Arrows at the beginning of each VL indicate its direction.

the viscid covering has moved back to within a short distance the point of attachment ('a' on R6) of the dry silk thread.*

3. She moves down R7 from H, taking this ST with her, and before reaching and attaching the ST at 'a' on R7, she pays with a fourth leg a short length of dry silk to correspond with attached at 'a' on R6. Thus the ST has a dry section at either

4. Returning along R7 to H, she then moves directly out again R6 to 'b', where she goes through the same procedure to span same sector (S6) closer to H, in a clockwise direction, and returns to H.

5. Moving directly to 'c' on R6 she spans S6 again in the direction, and after attaching the ST, returns with another ST to This ST she uses to span S7.

6. Returning to H she moves directly down to 'a' on R5, and still mo in a clockwise direction proceeds to span S5.

7. She follows this by spanning S6 and S7, forming a continuous across the three sectors.

8. Now, moving down R5, she spans S5, and follows by span S6 and S7, again forming a continuous VL across the same th sectors as last time.

9. Returning to H, the spider moves again down R6 to span S6, which she spans S7 and S8, making a continuous clockwise across the three sectors.

10. Moving down R6 once more, she spans S5 again, *but this in an anti-clockwise direction*, and then moves down R5 and S4 in the same direction, forming a continuous VL with the just placed across S5.

11. The ninth VL is formed by STs across S6, S7, S8 and S9 clockwise direction.

12. The tenth VL is formed by STs across S5, S4, and S3 anti-clockwise direction.

13. The eleventh VL runs clockwise from R6 across six sectors ends up attached at R1, which is the R leading to the spi retreat.

14. The twelfth VL runs anti-clockwise from R6 spanning four se

15. The thirteenth VL starts on R5 and runs clockwise across sectors, to end on R1.

16. The fourteenth VL runs anti-clockwise from R5 across four se and also ends up on R1. The two 'semi-circles' do not quite on either R1 or R6, but these two VLs form the first, and web the only, complete 'circle'.

The web is now finished, and the spider retires either to H the retreat.

There is a great deal of variation among individual webs in (a) the number of radials (R); (b) the number of viscid lines (VL) in each sector; (c) the maximum and minimum number of spanning threads (ST); (d) the ratio of the latter to one another; (e) the ratio of clockwise to anti-clockwise movements of the spider and (f) the number of lower radii that are used as starting points for VLs. (See Table I for comparative figures on some of the above variations).

The essential differences between the web-building procedures of *P. australasia* and that of, for example, any common species of *Araneus* making what could be called a 'typical' orb web, are summarised below. The web of *Araneus* is designated Web A and the web of *P. australasia* is designated Web B.

1. Web A has a temporary 'scaffolding' spiral of dry silk while Web B does not.

2. Most of the trap portion of Web A is made in the form of a continuous spiral, while no portion of Web B is made in this way.

3. The viscid silk of Web A is placed in position across the sectors by continuous movement of the spider around the hub at a decreasing distance from it, and the spider does not normally return to the hub until it has finished doing this. While the trap portion of Web B is also commenced at the periphery of the frame, the viscid silk is placed in position across each sector individually, and the spider returns to the hub after the spanning of each individual sector.

4. In Web A, points of attachment are measured off from the preceding turn of viscid silk by the spider's body. In Web B only the initial point of attachment of each viscid line is measured off in this way. Subsequent measurements appear to be based on the distance travelled to the hub while paying out the spanning thread, the spider returning the same distance along the next radial before attaching the other end of the spanning thread to it.

5. In Web A the viscid coating is extruded simultaneously with the dry silk of the spiral. In Web B the viscid coating is placed on the dry silk foundation only after sufficient of the latter has been extruded to span a given sector (though see *).

6. The viscid silk of Web A is laid continuously from beginning to end of spiral. In Web B the viscid silk is laid discontinuously, leaving a section of dry silk adjacent to each point of attachment.

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* It is possible that rather than paying a covering of viscid silk back along the dry line in the form of a tube, the spider continues to produce the line as before but starts at this point to give it a viscid covering while it is being produced. This would mean that, as the viscid portions extended backwards, the dry portion which is equal in length to the distance travelled by the spider between the point of attachment and the hub would have to contract to a fraction of its original length to remain as taut as it does. From observation, the first explanation seems more likely.

TABLE 1

Observed data for 35 webs of *P. australasia* (ST = spanning thre[illegible]

No. of radials	*Max. no. of STs*	*Min. no. of STs*	*No. of STs in sectors, clock[illegible] from retreat*
10			
7			
9	10	4	
11			
10			
10			
9	5	2	
10	4	1	
11			
10			
9			
10			
10	3	0	
9	3	0	
9			
9	6	1	
10			
9			
9			
10			
10			
11			
12	16	7	
9	12	1	
	7	3	
	7	2	
11	13	3	3,6,7,11,13,10,3,6,7,3
10	8	2	2,4,6,7,7,8,6,5,4,4
11	11	2	
10	8	2	4,4,5,6,8,7,7,6,4,2
10	11	5	5,6,6,7,10,11,7,6,6,6
10	10	0	
8	10	0	1,2,4,10,10,2,0
11	9	2	2,2,3,4,5,9,7,4,3,2,2
9	5	2	2,3,3,3,5,5,4,4,3
9	4	1	2,1,3,4,4,4,4,4,2
8	6	0	1,1,2,6,6,1,0,1

Maximum number of radials in one web .... 1[illegible]
Maximum number of STs in one sector .... 1[illegible]
Maximum discrepancy between max. and min. STs in one web ... 1[illegible]
Web count according to number of radials, the latter in brackets: 1(1[illegible]
6(11); 14(10); 11(9); 2(8); 1(7).

The 'floating' appearance of the web of *P. australasia* is enhanced by a variation in the method of adding the viscid material to the dry silk line. This is seen often in the webs of immature spiders, and may be a way of economising on viscid silk. Instead of a continuous covering, the viscid silk is paid out in a series of short sections, varying in both length and number according to the width of the sector spanned by the relevant spanning thread. There may be up to 15 of these short sections on one spanning thread, usually between 5 mm and 7 mm long, with shorter spacers of dry silk between them. Spanning threads of some webs contain both continuous and broken sections of viscid silk, but the construction of such webs has not been observed, and the broken sections may have run together. These sections are produced as the spider pays out the viscid silk.

A later development with webs that contain these short sections (and perhaps with others) is that the droplets forming each section may run together to form a single large drop. Separate rows of up to 10 of these large drops are clearly visible at a distance, like pearls strung together to form a multi-strand necklace.

The advantages of having the spanning threads attached by non-viscid silk becomes obvious when a small moth, which seems to be the usual prey of this species, flies into the web. The openness of the web ensures that the moth will not usually adhere to more than one spanning thread. When it is caught, the spanning thread breaks at one end so that the moth dangles, and thus its attempts to escape have little effect on any other part of the web. When this happens the spider runs to the hub if she is not already there, and appears to test various radials with her tarsi. Then she runs along the correct radial, either hauls up or runs down the broken spanning thread, bites the dangling moth and wraps it loosely in silk. The immobilised and wrapped prey is usually taken to the hub or the retreat, or may be left *in situ* for a while.

Spanning threads from which moths or other insects have escaped or been removed, and from which much of the viscid silk has been lost, can on close inspection be seen hanging from a radial. These missing spanning threads account for many irregularities seen on first looking at a web. The viscid lines are extremely sticky and very elastic, and this elasticity is another factor that helps keep the struggling prey clear of the web, because even if the spanning thread fails to break at one end, the trapped insect still hangs well below the plane of the web.

Reference

Goodwin, P. M., 1961. Biological and synoymic notes on the genus *Poecilopachys* Simon (Araneida, Argiopidae) *Proc. R. zool. Soc. N.S.W.* 1959-60: 72-78.